60130-1987
03MRA0008

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	Thomas et al.
Serial No.:	Unknown
Filed:	Herewith
For:	DISC BRAKE ASSEMBLY
Docket No.:	60130-1987; 03MRA0008

TRANSMITTAL OF CERTIFIED COPY

Commissioner for Patents
P.O. Box 1450
Alexandra, VA 22313-1450

Dear Sir:

With regard to the above-referenced patent application, enclosed is a Certified Copy of prior corresponding document United Kingdom Patent No. 0302186.2.

Respectfully submitted,

CARLSON, GASKEY & OLDS

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Dated: January 16, 2004

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Amy M. Spaulding

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Concept House
Cardiff Road
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1/77

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The Patent Office
Cardiff Road
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1. Your reference P303938GB/JBJ P48758/000

2. Patent application number *(The Patent Office will fill in this part)* 0302186.2 30 JAN 2003

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

Meritor Heavy Vehicle Braking Systems (UK) Limited
Grange Road
Cwmbran
Gwent
NP44 3XU
United Kingdom

07582320002

Patents ADP number *(if you know it)*

If the applicant is a corporate body, give the country/state of its incorporation: United Kingdom

4. Title of the invention: A Disc Brake Pad Spring

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

WITHERS & ROGERS
Goldings House
2 Hays Lane
London
SE1 2HW

Patents ADP number *(if you know it)* 1776001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(answer 'Yes' if:*
a) any applicant named in part 3 is not an inventor, or
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c) any named applicant is a corporate body.
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YES

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Continuation sheets of this form	
Description	7
Claim(s)	3
Abstract	
Drawing (s)	5

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	One
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature W Jones pp Regus Date 30/1/03

12. Name and daytime telephone number of person to contact in the United Kingdom — John B Jones — 0121 245 3900

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P303938GB

A Disc Brake Pad Spring

The present invention relates to a disc brake pad spring.

Known disc brakes (shown in figures 1 to 4) comprise a disc or rotor 20 mounted to a wheel hub for rotation with a vehicle wheel. A brake carrier 12 is fixed relative to the axis of rotation of the rotor 20 and is secured to a non-rotating portion of the vehicle (eg the vehicle suspension). In "floating caliper" type brakes, a brake caliper comprising a bridge 16 secured to a housing 14 is slidably mounted on the carrier 12 to allow for movement parallel to the axis of rotation of the rotor 20. An actuator 18 communicates with one or more pistons or tappets (not shown) provided in housing 14 to apply the force required for the brake to function.

A pair of brake pads 22 comprising friction material 36 mounted to a solid backplate 34 are positioned either side of the rotor 20 with the friction material facing the planar faces of the rotor. The backplates 34 of the pads 22 are seated on vertical and horizontal abutment regions 28 and 30 respectively provided in openings 32 of the carrier 12 to restrain the pads 22 from rotational and radially inward movement respectively. In a typical floating caliper type brake, one of the backplates 34 engages with the piston(s), either directly or via a spreader plate to distribute the load. Braking is achieved by the actuator causing the piston to push one of the pads 22 towards the rotor 20. Because the caliper is able to "float" on the carrier, this causes an equal frictional braking load to be applied by both pads.

Backplates 34 of vehicle disc brakes pads 22 essentially perform two functions: they provide a solid support for slidably mounting the friction material 36 of the brake within the brake carrier in such a way to transmit shear loads induced on the friction material during braking to the carrier, and they transmit and distribute the pressure applied by brake tappets or pistons during braking evenly to the surface of the friction material to ensure even wear of the friction material over its surface. In order to perform the former of these two functions it is common for resilient means such as a leaf type pad springs 24 to restrain radially outward movement (indicated by arrow R) of the pads in the carrier whilst

permitting movement towards and away (indicated by arrow A) from an associated brake disc and to prevent rattling of the pad in use.

Pad springs 24 are typically elongate and extend along a proportion of the radially outermost face of a brake pad backplate 34 when fitted. Pad springs 24 are typically pre-loaded to a certain extent against the carrier by a pad retainer 26 which spans an opening between the bridge 16 and housing 14 and that contacts the approximate centre of the spring. This force is typically reacted radially outwardly by contact with the backplate proximate each end of the spring. Formations are also typically provided on the backplate and/or the pad spring to retain the pad spring on the backplate during movement of the pad 22 parallel to the axis of rotation of rotor 14.

During brake actuation, the brake pad backplate and the pad spring moves towards and away from the brake disc. If the retainer and the spring are not parallel (due to loads on the pad spring and/or uneven brake pad wear) there is a tendency for the edge 25 of the pad spring to indent into the underside 29 of the pad retainer. This can prevent movement of the backplate which inhibits braking performance. This problem is increased where heavy brake pads are used, since a stiffer pad spring is required which has a greater tendency to indent into the pad retainer.

An object of the present invention is to provide an improved disc brake pad spring.

According to the present invention there is provided a disc brake pad spring for a disc brake pad, the pad defining a radial direction, the pad spring having a surface for abutment with an associated pad retainer to restrain radial movement of the pad, in which the surface is defined by a profile which includes at least one rounded edge so as to prevent the pad spring from indenting into the pad retainer.

By providing a rounded profile to the edge of the pad spring there is a reduced tendency for the pad spring to indent into the pad retainer, and therefore free movement of the pad spring and therefore the backplate is maintained.

Preferably the pad spring includes an aperture into which a protrusion from a brake pad backplate locates so as to prevent axial movement between the pad spring and the backplate.

The present invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a plan view of a disc brake incorporating a prior art disc brake pad assembly;

Figure 2 is an end view of the disc brake of figure 1,

Figure 3 is an end view of a portion of the carrier and one prior art disc pad and pad spring of figures 1 and 2,

Figure 4 is a front view of a portion of the pad retainer and pad spring of the disc brake pad assembly of figures 1 to 3,

Figure 5 is a plan view of a pad assembly including a pad spring according to the present invention,

Figure 6 is an end view of a portion of the pad assembly of figure 5,

Figure 7 is a front view of a portion of the pad assembly of figure 5, and

Figure 8 is a enlarged front view of a portion of the pad assembly of figure 5.

With reference to figures 5 to 7 there is shown a disc brake pad assembly 133 according to the present invention. The assembly 133 is capable of being fitted into a prior art disc brake 10 as described above. The assembly 133 comprises a backplate 134 to which friction material 122 is secured. The backplate comprises a pair of curved surfaces in the form of circumferentially spaced abutments 140 on the radially outer edge 135 thereof. The backplate 134 also include protrusions in the form of a pair of radially outwardly

extending lugs 150 which project from the radially outer edge 135 of the backplate 134 and are located between abutments 140.

As can be seen from figures 5 and 6, pad spring 124 is elongate having a length L, with a central portion 148 half way along the length of the spring, and end regions 149. The central portion defines the maximum width W_2 of the spring, with the remaining part of the spring having a reduced width W_1. The spring is stamped from sheet metal and is typically 1mm thick.

When fitted to the backplate 134, the pad spring 124 extends in the circumferential direction transverse to the axis of movement of the backplate 134 towards and away from rotor 20 when in use (indicated by arrow A). The spring is provided with upturned ends 142 and two apertures in the form of slots 152 positioned at end regions 149 such that lugs 150 may fit therethrough. The abutments 140 on backplate 134 are shaped such that the upturned ends 142 of the pad spring are prevented from sliding over them. Location of lugs 150 in slots 152 prevents axial movement between the spring and the backplate.

It can be seen from figure 6 that when installed, up turned end 142 are spaced slightly from their associated abutments 140. Similarly, the circumferential ends of each slot 152 is spaced slightly from its associated lug 150. Consideration of figure 3 shows that, when installed, spring ends 42 are in permanent engagement with their respective abutment 40. This permanent engagement reduces the tendency of spring 24 to tip relative to the backplate. It can be seen that an equivalent feature is not found on assembly 133. Therefore the present invention is particularly applicable to brake backplates having lugs which project through holes in the pad spring since such designs are inherently more prone to the tipping of the spring relative to the pad.

In other embodiments of the present invention axial movement may be prevented by other means. For example, a spring according to the present invention may include protrusions (similar to protrusion 146 (figure 3) of the prior art) which wraps around the backplate.

A radially inner surface 127 of a pad retainer 126 holds down the central portion 148 of the pad spring 124 by abutting against it. The area of the pad spring in contact with the pad retainer 126 defines a surface 170. With reference to figure 8 it can be seen that the surface 170 is defined by a profile which has a substantially planar section 180 and two rounded edges 171 of radius Q. In other embodiments the profile could be elliptical, or any other form which provides at least one rounded edge.

Typically the spring is formed from sheet metal. Typically a blank will be stamped from sheet metal (either including holes 152, or alternatively these holes being stamped at a later stage). The blank will then have subsequent pressing operations performed on it to form the requisite final shape. Advantageously, the rounded edges 171 can be formed as part of a pressing process.

The pad retainer is secured to an outboard end of the brake carrier by a securing feature in the form of a bolt 173. The dotted line 177 of figure 7 shows the inside profile of the wheel to which the disc brake assembly is fitted. It can be seen that space between the assembly, in particular the pad retainer and the wheel profile, is restricted. Thus the pad retainer which is mounted on the carrier is shaped so as to locate within the space provided. The radius of surface 127 of the pad retainer is R_1, and the radius of the securing feature is R_2 (necessarily less than R_1, in view of the space envelope). Both radii having a centre at the wheel axis (indicated by P). To accommodate the location of the securing feature on the brake carrier, the retainer includes bends 126A and 126B. Bend 126A includes a radius T which is substantially the same as the radius Q of the rounded edge of the pad spring surface 170. In this embodiment, T and Q are in the range between 5.25 mm and 6.75 mm. In other embodiments, this range can be widened. In particular bend 126A accumulates the fact that bolt 173 is at a smaller radius than surface 127.

Prior to fitting the pad spring 124 onto lugs 150, the spring has an arcuate profile with a shorter radius of curvature than is shown in figure 6. To fit the pad spring 124 to the backplate, it must be compressed by a certain amount for the slots 152 to fit over both lugs 150. Once fitted, a certain amount of relaxation occurs such that the circumferentially outermost edge of slots 152 contact the radially outermost face of lugs 150, thereby

retaining the spring on the backplate 134 prior to the mounting of the assembly 133 in the brake 10. In other embodiments, the lugs 150 may not perform this circumferential retaining function.

In figure 6 the pad assembly 133 is shown in its assembled state on disc brake 10 with pad retainer 126 in place. It should be noted that the pad retainer 126 depresses the central portion 148 of the spring 124 such that the circumferentially outermost edges of slots 152 no longer contact lugs 150, but a space between these circumferentially innermost edges of holes 152 and the lugs 150 remains.

When the backplate 134 is subjected to radially outward accelerative loads due to, for example, a vehicle to which the backplate is fitted travelling over uneven terrain, the loads cause the distance S between the retainer 126 and central region 144 of the backplate to decrease. In turn, this causes the spring 124 to straighten along its length and the ends 142 thereof to slide circumferentially outwardly up until they come into contact with abutments 140. Thereafter, further deflections towards the radially outermost face 135 of the backplate up to position 166 have a significantly higher spring rate due to spring 124 entering an elastic "buckling" mode of deflection in which the central portion 148 continues to straighten, but the portions intermediate the central portion and the ends are forced to curve away from radially outer face 135.

During radial movement as described above, the central portion 148 of the pad spring and the retainer 126 are in contact over surface 170, with the retainer restraining radial movement of the pad.

Actuation of the brakes results in the movement of the pad towards the rotor in the direction of arrow A and thus movement of the spring relative to the pad retainer. In known pad springs (shown in figure 4), the pad spring has a sharp edge 25 which tends to indent into the underside 29 as the pad spring moves relative to the pad retainer and the pad and spring are not in a parallel relationship. As soon as the underside of the pad retainer is indented, sliding of the brake pad relative to the retainer is inhibited, as the surface (even when the retainer and spring are parallel) is no longer smooth. It would be appreciated that

typically the pad spring will be stamped from sprung steel. The pad retainer, on the other hand can be made from material that it is not as hard as spring steel (since the material of the retainer is not required to perform any "spring" function). This difference in hardness of materials exaserpates the problem of the pad spring indenting into the pad retainer.

The present invention solves this problem, since the rounded edge profile of the pad spring ensures that even when the pad spring surface and the retainer are not parallel, the rounded edge does not indent into the pad retainer and therefore movement of the pad spring is not inhibited and braking performance is not affected.

It should be understood that numerous changes may be made within the scope of the present invention. For example, alternative means of securing the pad spring to the backplate may be employed, as may other suitable shapes of the pad spring end and abutment (e.g. such as inwardly curved or straight ends). The circumferential restraint need not occur at the extreme ends of the spring. For example the abutments for providing circumferential restraint may be the circumferential inner faces of the lugs which restrain the circumferentially inner edges of the slots.

Claims

1. A disc brake pad spring for a disc brake pad, the pad defining a radial direction, the pad spring having a surface for abutment with an associated pad retainer to restrain radial movement of the pad, in which the surface is defined by a profile which includes at least one rounded edge so as to prevent the pad spring from indenting into the pad retainer.

2. A disc brake pad spring according to claim 1 in which the surface profile is defined by a substantially planar section with at least one rounded edge.

3. A disc brake pad spring according to claim 2 in which the pad surface has two rounded edges.

4. A disc brake pad spring according to claim 1 in which the surface profile is substantially elliptical.

5. A disc brake pad spring according to any preceding claim in which the pad spring is substantially elongate being defined by a length and a width.

6. A disc brake pad spring according to claim 5 in which the surface is located on a central portion of the pad spring, the central portion being located substantially half way along the length of the pad spring.

7. A disc brake pad spring according to claim 6 in which the central portion defines a maximum width of the pad spring, and the remainder of the pad spring has a reduced width.

8. A disc brake pad spring according to any preceding claim in which the pad spring has a curved profile in the lengthwise direction.

9. A disc brake pad spring according to any preceding claim in which the spring has radially outwardly curved ends so as to radially retain the pad spring on an associated backplate.

10. A disc brake pad assembly including a backplate and a pad spring according to claim 9, in which the backplate has complementary curved surfaces for abutment with the spring curved ends.

11. A disc brake pad assembly including a backplate and a pad spring according to any one of claims 1 to 9 in which the spring includes an aperture and the backplate includes a protrusion which locates in the aperture so as to prevent axial movement between the spring and the backplate.

12. A disc brake pad assembly including a backplate and a pad spring according to any one of claims 1 to 9 in which the spring includes a protrusion which locates around the backplate so as to prevent axial movement between the spring and the backplate.

13. A disc brake assembly including a pad spring according to any one of claims 1 to 9.

14. A disc brake assembly including a brake pad, a pad retainer, a brake caliper and a pad spring according to any one of claims 1 to 9, the pad retainer being secured by a securing feature at an outboard end to the brake caliper at a radius smaller than the radius of the pad spring surface, the retainer including a retainer radius to accommodate the positioning of the securing feature at said smaller radius, in which the retainer radius is substantially the same as the radius of the rounded edge of the pad spring.

15. A disc brake assembly according to claim 14 in which the retainer radius is between 4 mm and 8 mm, preferably between 5 mm and 7 mm, and more preferably between 5.25 and 6.75 mm.

16. A disc brake pad spring according to any one of claims 1 to 9, or a disc brake pad assembly according to any one of claims 10 to 12, or a disc brake assembly according to any one of claims 13 to 15 in which the pad spring is made from sheet metal.

17. A disc brake pad spring or a disc brake pad assembly or a disc brake assembly according to claim 16 in which the pad spring is stamped from sheet metal.

18. A disc brake pad spring or a disc brake pad assembly or a disc brake assembly according to claim 16 or 17 in which the at least one rounded edge is formed as part of a pressing process.

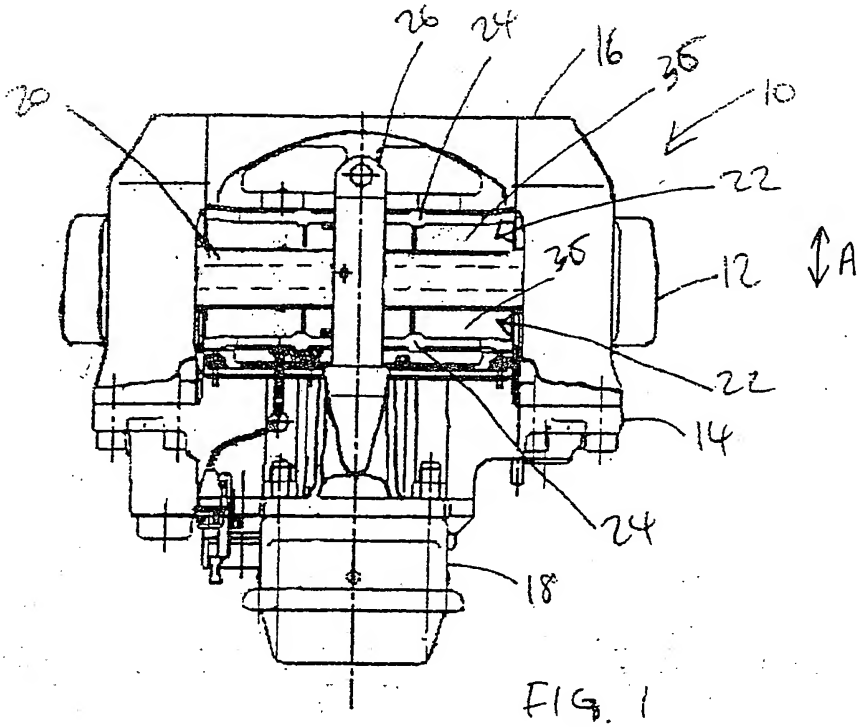

FIG. 1
(PRIOR ART)

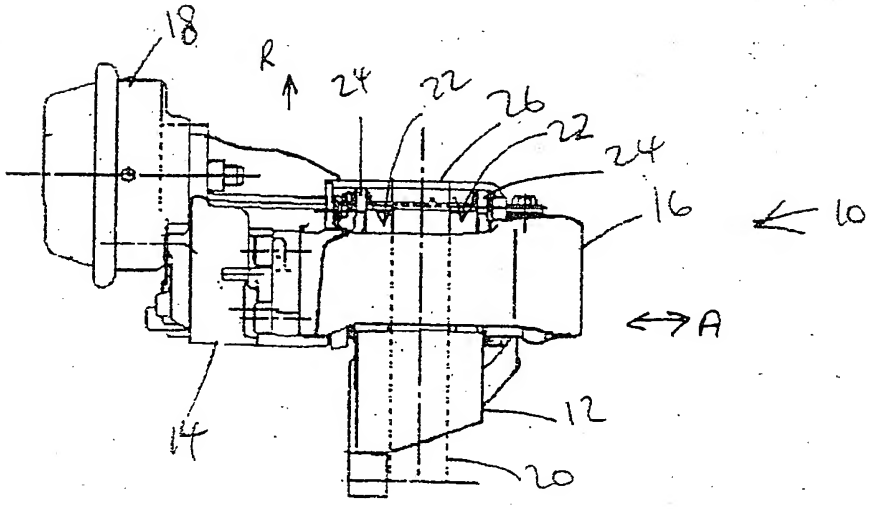

FIG. 2
(PRIOR ART)

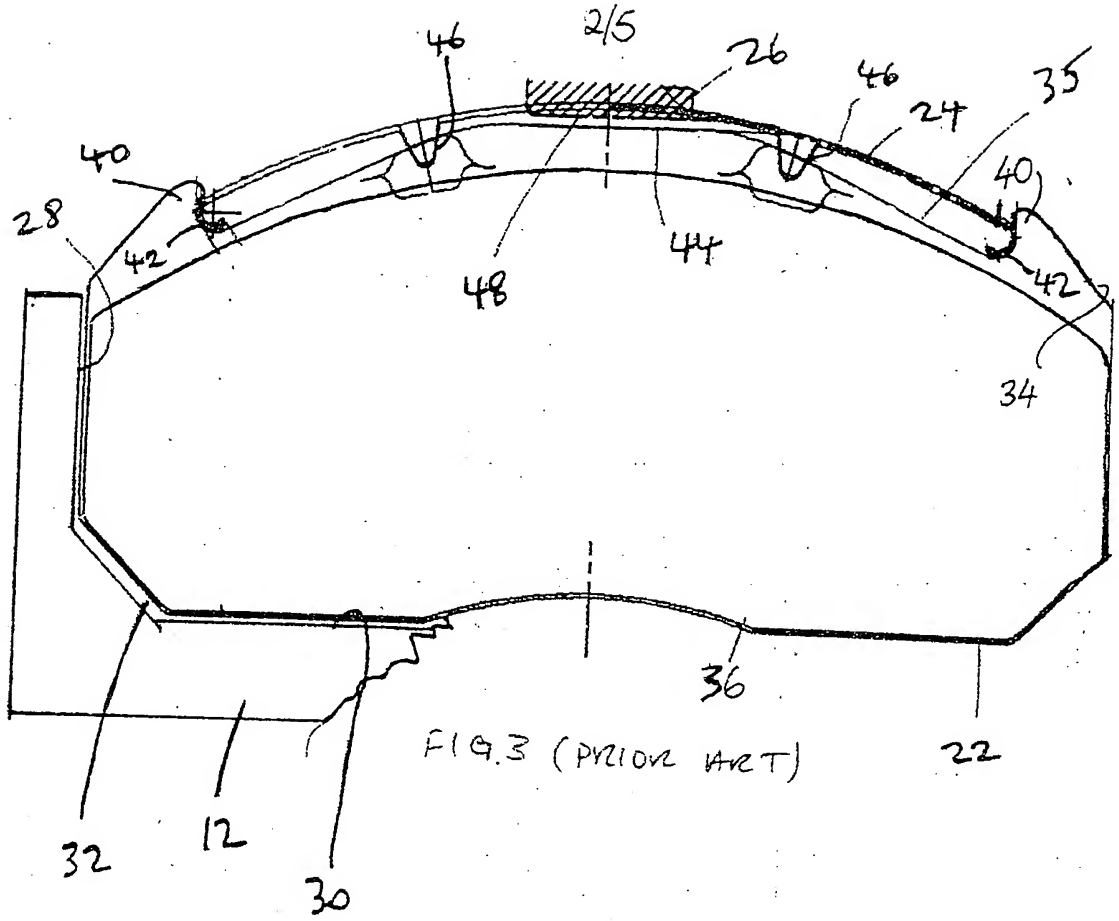

FIG 3 (PRIOR ART)

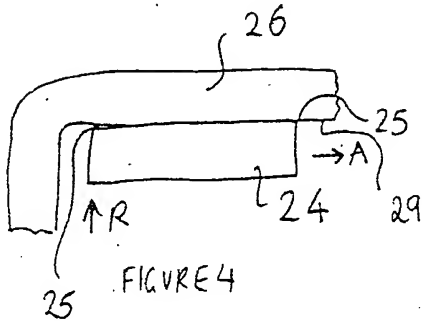

FIGURE 4

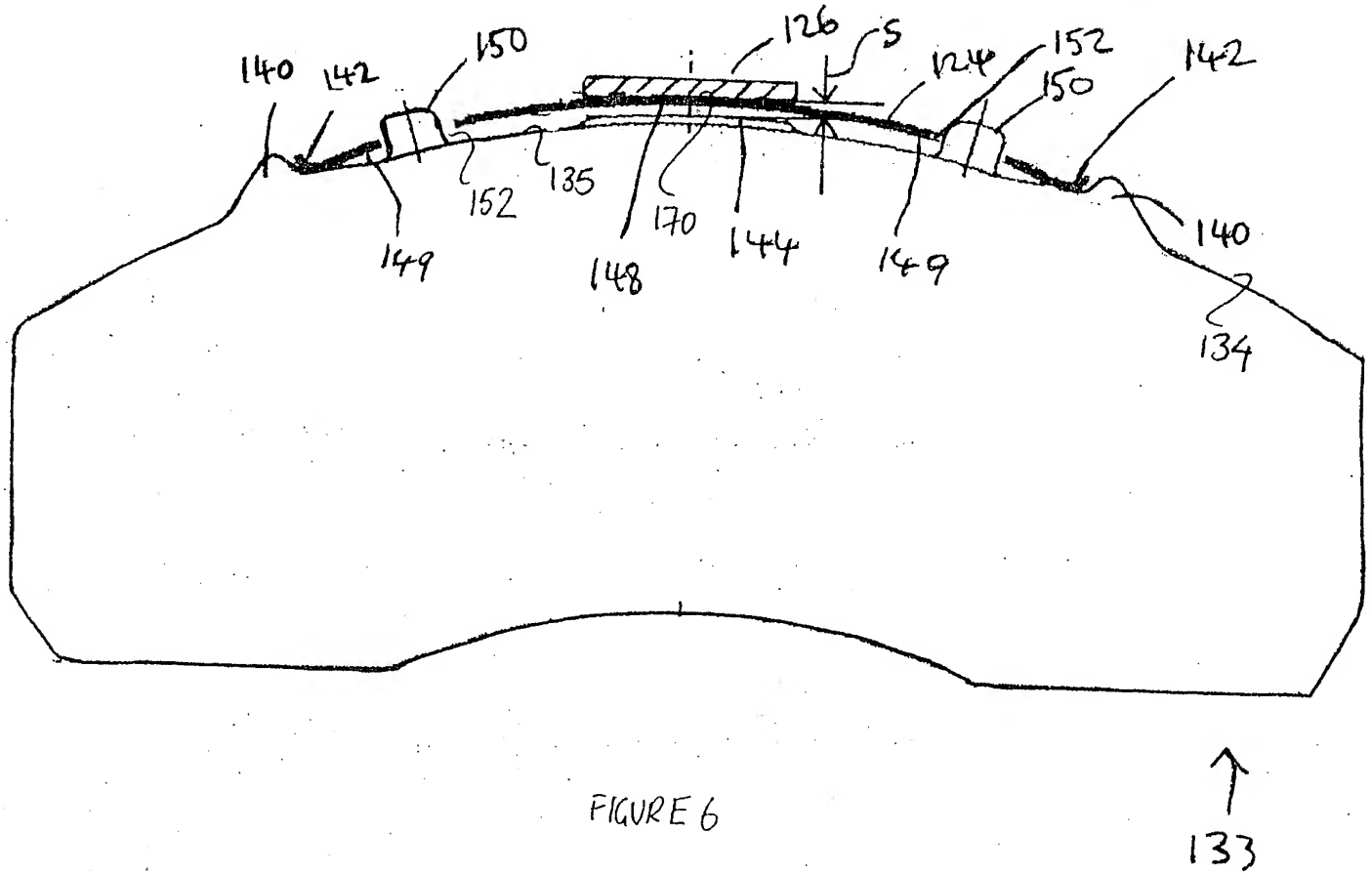
140
142
150
126
S
124
152
150
142
135
152
170
144
149
149
148
140
134
133

FIGURE 6

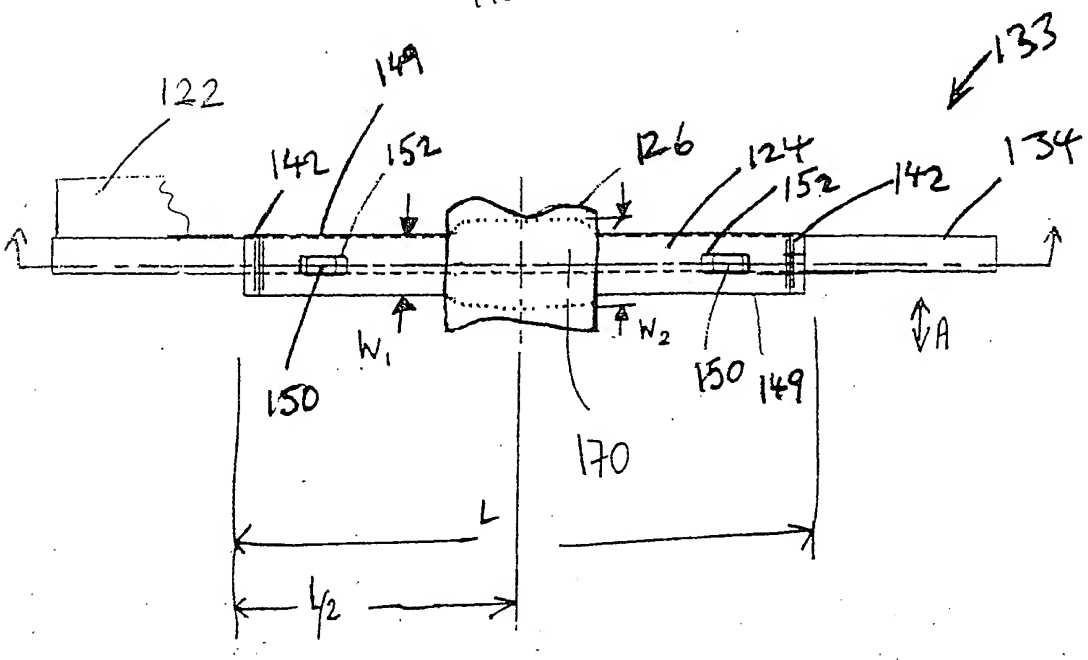

Figure 5

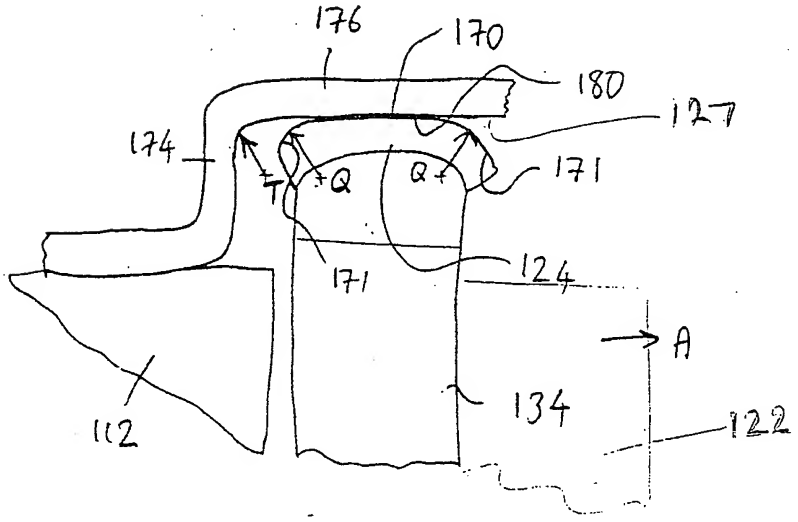

FIGURE 8

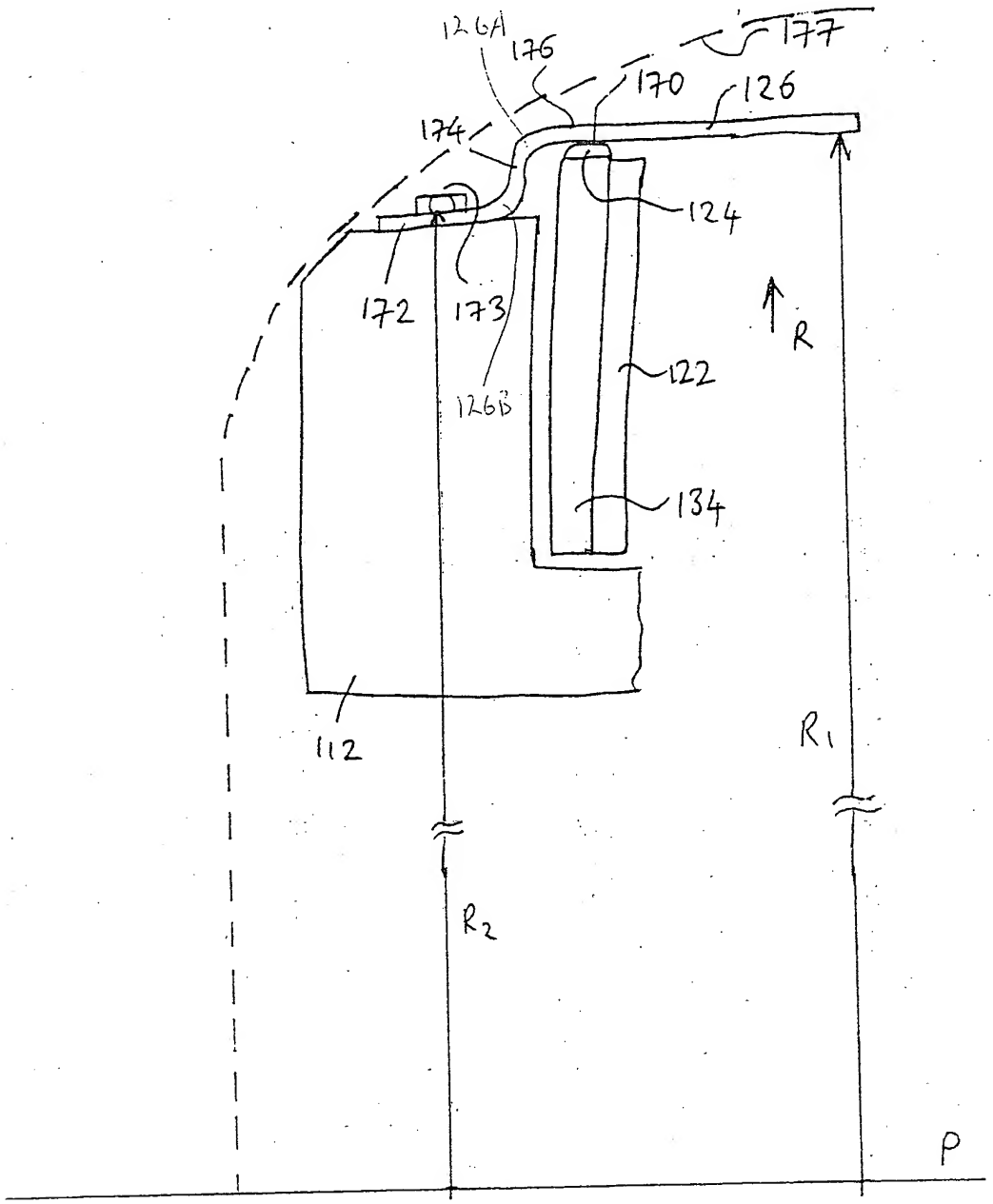

FIGURE 7